The regression equations shown in the figures as continuous lines are:

$y=0.84\times0.54$ Center Hall on State College (1909, 1922, 1930 excluded).
$y=0.57\times3.03$ Titusville on Merritts Island.
$y=3.11\times1.99$ Boulder Creek on Campbell.

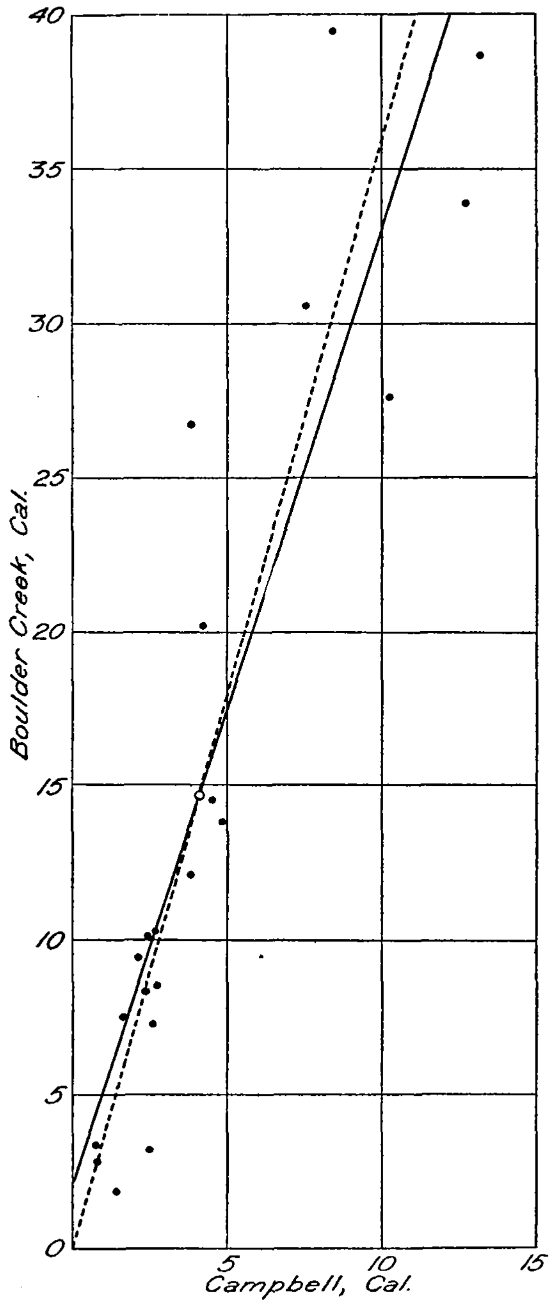

FIGURE 3.—Correlation of January rainfall, 20 years

where the amounts are in inches of rain per month.

The equations representing Mr. Grunsky's method are:

$$y=0.995\times$$
$$y=1.015\times$$
$$y=3.60\times$$

and these appear on the diagrams as dotted lines.

The results of the comparison are as follows:

	Sum of squares of deviations	Standard deviation	Probable error	Mean deviation	Maximum deviation
Center Hall:					
Regression	22.3470	0.86	0.59	0.75	1.85
Normals	29.0337	.97	.67	.77	1.88
Difference	6.6867	.11	.08	.02	.03
Titusville:					
Regression	316.3134	3.05	2.08	2.17	8.14
Normals	329.1524	3.11	2.13	2.39	7.79
Difference	12.8390	.06	.05	.22	-.35
Boulder Creek:					
Regression	527.7698	5.14	3.55	3.80	12.53
Normals	577.5369	5.37	3.72	3.91	12.60
Difference	49.7671	.23	.17	.11	.07

These results indicate that Mr. Grunsky's method is satisfactory for practical purposes, with the advantage of eliminating a great deal of arithmetical work. The normals should be based on simultaneous data.

The preparation of a scatter diagram is not very laborious, and affords valuable information about the closeness of correlation.

HIGH FLIGHTS OF SOUNDING BALLOONS[1]

By E. FRANKENBERGER

[Deutsche Seewarte Hamburg]

The author expresses the fact that most of our knowledge of the composition of the stratosphere is gained by indirect methods, and that it would be valuable if air-soundings, with direct measurements, were made to heights of over 30 km.

In the spring of 1929 the meteorological experimental bureau of the Deutsche Seewarte undertook to solve the problem of getting measurements at high altitudes by systematic sounding balloon flights. Mathematical calculations of the forces of expansion in partially elastic balloons were made, and by research the elastic qualities of balloon rubber and the most favorable amount of gas for sounding balloons were determined. As a result, a sounding balloon on November 2, 1929, reached a height of 35 km.

The question of the dependence of thermometer lag on the rate of ascent is taken up and also the problem of ventilation. The author says that the condition for attaining the greatest altitude is that the balloon rise until is reaches its floating level and then burst. To accomplish this it is stated, they must be inflated so that they rise slowly in the lower levels and that this slow vertical motion (180 to 240 m. per minute) gives poor ventilation. Thus the true temperatures must be calculated from the indicated temperatures by the use of thermometer lag factors. Investigations into the dependence of thermometer lag on air densities and ventilation are in progress for the tropospheric air densities and are under consideration for the small air densities of the stratosphere.

Five balloons 2,500 mm. (98 inches) in diameter were specially prepared for high flights during the international

[1] Analen der Hydrographie und Maritimen Mwteorologie, Jan., 1931, pp. 20-22.

month of September, 1930. The days with high flights were the 8th, 13th, 14th, 24th, and 25th.

Computation of the record of September 8 gave a maximum altitude of 35.9 km. A small Bosch instrument was used and due to the multiple adjustments of the pressure element, a deflection of a few tenths of a millimeter of the pressure pen would produce an error ±3 km. in the maximum altitude. Calculating the height only from the hydrogen filling, the size of the balloon, and from the bursting point and elasticity of the balloon rubber, a maximum altitude of 33 km. is obtained. Also, in favor of the maximum altitude of 33 km. is the fact that with it the rate of ascent in the upper levels is constant, while a maximum altitude of 35.9 km. gives an improbable increase in rate of ascent in the highest level.

On September 13 the balloon was equipped with a large Bosch instrument. For this instrument the maximum altitude of 26.5 km. is probably not more than ±0.5 km. in error. This balloon burst prematurely, due possibly to strain caused by the greater weight of the instrument.

September 14 another small instrument was sent up. It entered a cold current at 24 km. and the balloon stopped rising for a time, then went up again and burst at 32.5 km. The pressures and temperatures of the higher layers were obtained from the descent record.

The ascents on the last two days did not reach the desired heights.

The nine flights in September, 1930, reached a mean maximum altitude of 23 km. It is possible to reach altitudes of over 30 km. only with great care and considerable expense.

The results of these high flights together with the higher Hamburg flights from 1926 to 1930 are to be published soon. These results show that an increase of temperature at heights over 30 km. can not be firmly established. The three highest flights of September, 1930, show minimum temperatures of about −55° C. at about 12.5 km. and temperatures approximately 8° higher at the maximum altitudes. This might be partly due to insufficient ventilation and radiation effect.

The results of the September flights indicate that for further work, investigation should be made into air density and ventilation effects on temperature measurements and the following problems are to be solved: (1) Improvement of the pressure measurements; (2) improving the quality of rubber; (3) development of a connecting apparatus whereby the weight of the instrument is distributed evenly over the balloon.—*Translated and abstracted by J. C. Ballard, U. S. Weather Bureau.*

AGREEMENT FOUND IN RECORDS OF FERGUSSON SOUNDING-BALLOON METEOROGRAPHS

By L. T. SAMUELS

[Weather Bureau, Washington]

During the series of sounding-balloon observations made at Royal Center, Ind., during February, 1931 (international month), two meteorographs were attached to the same balloon in a few instances in order to determine the agreement between the individual records. Also, on a few days sounding balloons were released shortly before and shortly after sunset in order to determine any possible effects of insolation on the meteorograph.

In Figure 1 are shown the temperature-altitude graphs of an observation made February 7 when two meteorographs were attached to the same balloon. Meteorograph No. 693 was hung about 80 feet below the balloon and No. 679, about 15 feet lower. The ascensional rate averaged 215 meters per minute up to 9 km. and 187 meters per minute to the highest altitude reached, viz, 17 km. Each of the records was computed independently and an inspection of the graphs (fig. 1) shows very close

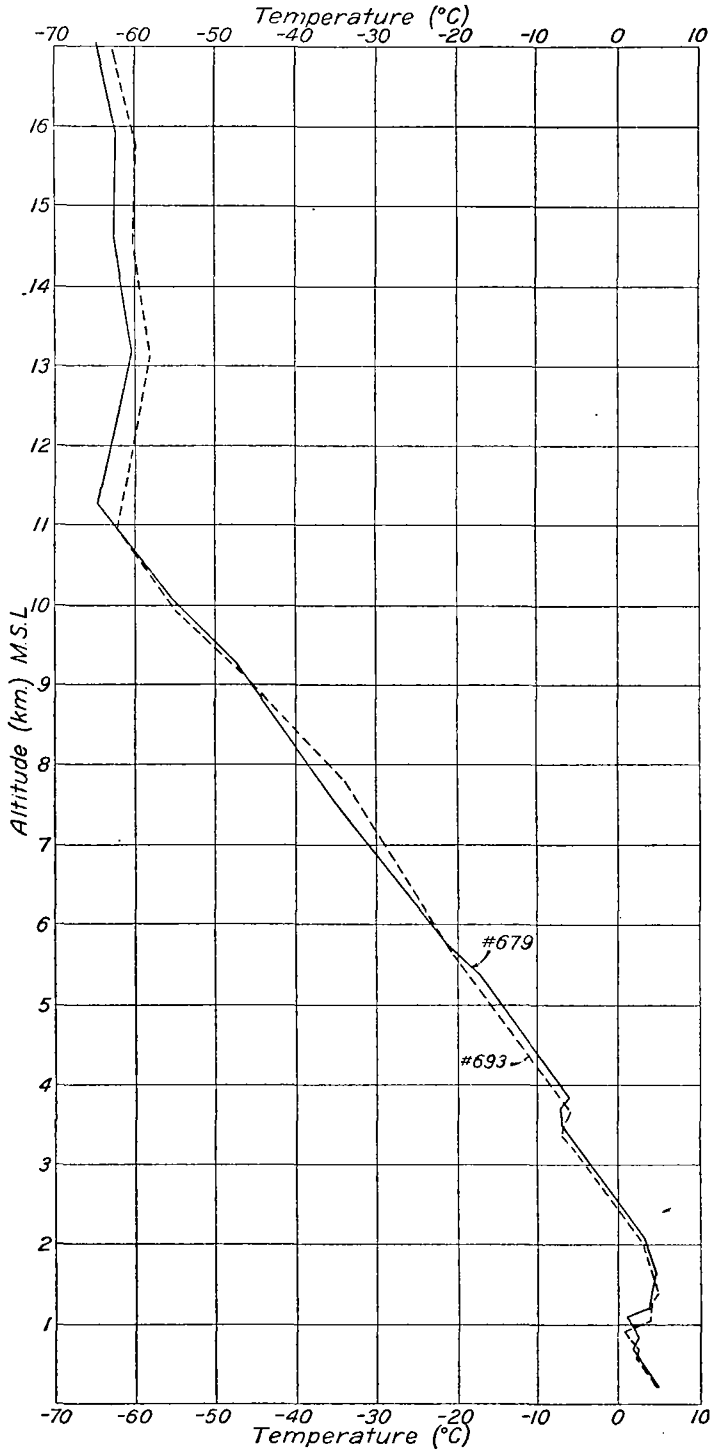

FIGURE 1.—Temperature-altitude graph of sounding-balloon observation using two meteorographs

agreement. It will be noted that at no point does the temperature recorded by both instruments differ by more than 3° C. Two marked inversion layers are shown between 1 and 2 km. and between 3 and 4 km., respectively. The height of the base of the stratosphere agrees to within 300 meters, or 3 per cent. The variations in lapse rate in the stratosphere are in striking agreement.